Excerpt from Module Descriptions

Master of Science Energy Science and Technology

Examination Regulations in the Version of: 2014

Sub-Section: Materials Science
Index

Materials Science

Materials Science 1
# Materials Science

Modules referring to Materials Science

<table>
<thead>
<tr>
<th>Code</th>
<th>8833270978</th>
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<tbody>
<tr>
<td>ECTS credits</td>
<td>10</td>
</tr>
<tr>
<td>Attendance time</td>
<td>8</td>
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<tr>
<td>Language of instruction</td>
<td>English</td>
</tr>
<tr>
<td>Duration</td>
<td>2 semester Semester</td>
</tr>
<tr>
<td>Cycle</td>
<td>starts every Winter Semester</td>
</tr>
<tr>
<td>Coordinator</td>
<td>Prof. Dr. U. Herr, Faculty of Engineering and Computer Science</td>
</tr>
<tr>
<td>Instructor(s)</td>
<td>Prof. Dr. U. Herr and lecturers of the Faculty of Engineering and Computer Science</td>
</tr>
<tr>
<td>Allocation of study programmes</td>
<td>First and second semester MSc Energy Science and Technology</td>
</tr>
<tr>
<td>Recommended prerequisites</td>
<td>Fundamentals of mathematics, physics and chemistry</td>
</tr>
<tr>
<td>Learning objectives</td>
<td>Materials Science I</td>
</tr>
<tr>
<td></td>
<td>Students should be able to</td>
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<tr>
<td></td>
<td>• classify metallic, ceramic and polymeric materials based on their structure on the atomic scale, microstructure and macroscopic properties.</td>
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<td></td>
<td>• analyze different materials with respect to mechanical strength.</td>
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<td></td>
<td>• understand the physical basis for thermal, electrical and magnetic properties of solid materials.</td>
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<tr>
<td></td>
<td>Materials Science II</td>
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<tr>
<td></td>
<td>Students should be able to</td>
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<tr>
<td></td>
<td>• interpret the influence of the processing of a metallic alloy, ceramic and polymeric substance on its microstructure and properties.</td>
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<tr>
<td></td>
<td>• relate the structure of a composite material to improved strength and toughness.</td>
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<td>• select appropriate materials and processing routes for the realization of an engineering design goal, based on properties and performance characteristics.</td>
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Syllabus

Materials Science I

- Classification of materials with respect to chemical bond and structure.
- Crystal structure: Symmetry classes, lattices, reciprocal lattice, diffraction.
- Defects in solids: Point defects, dislocations, grain and phase boundaries.
- Characterization of the microstructure: Microscopic methods (optical, SEM), diffraction techniques (XRD, TEM), scanning probe techniques (introduction).
- Phase diagrams: Thermodynamics of solutions, chemical potential, phase equilibrium, basic types of phase diagrams, important examples.
- Transport: Diffusion (macroscopic and microscopic description), diffusion at surfaces and interfaces, electromigration, thermodiffusion.
- Phase transformations: Thermodynamics and kinetics, diffusive transformations, non-diffusive transformations.
- Mechanical properties: Elasticity, plastic deformation, viscous flow and creep, fracture.

Materials Science II

- Application of basic concepts introduced in part I of the lecture to different classes of materials: Metallic alloys, ceramics, glasses, polymers.
- Processing/optimization of materials, heat treatment
- Electrical properties of materials
- Semiconductors
- Magnetic properties of materials
- Optical properties of materials

Literature


Teaching and learning methods

Materials Science I

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Lecture</th>
<th>Exercise</th>
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<tbody>
<tr>
<td>Materials Science I</td>
<td>5</td>
<td>3 h/wk</td>
<td>1 h/wk</td>
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Materials Science II

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Lecture</th>
<th>Exercise</th>
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<tbody>
<tr>
<td>Materials Science II</td>
<td>5</td>
<td>3 h/wk</td>
<td>1 h/wk</td>
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Workload

Materials Science I:

- Total: 150 h
- Lecture: 48 h (presence)
- 38 h preparation and revision
- Solving problems: 16 h (presence)
- 32 h revision
- Exam: 16 h preparation
Materials Science II:
Total 150 h
Lecture: 42 h presence
50 h preparation and revision
Solving problems: 14 h presence
28 h revision, solution of exercises
Exam: 16 h preparation

Assessment
The credit points will be awarded once the written or the oral exams have been passed (depending on the number of participants). No prerequisites are necessary for exam registration.

Grading procedure
The grade of the module will be the arithmetic mean of the respective grades of the partial module exams weighted by their credit points.

Basis for
Module Energy Science and Technology III-Electrochemical EST MSc Energy Science and Technology